

**REMARKS**

Reconsideration of this Application is respectfully requested. Applicant has addressed every objection and ground for rejection stated in the present Office Action, and believes the Application is now in condition for allowance.

**1. Statement of the Case and Status of the Claims.**

The present invention is directed to a novel electrode active material represented by the nominal general formula:



wherein,

- (a) A is selected from the group consisting of Li, Na, K, and mixtures thereof, and  $0 < a \leq 8$ ;
- (b) M comprises one or more metals, wherein at least one of the one or more metals is capable of undergoing oxidation to a higher valence state, and  $1 \leq b \leq 3$ ;
- (c) Z is selected from the group consisting of a hydroxyl, a halogen, and mixtures thereof, and  $0 < d \leq 6$ ;

wherein A, M, Z, a, b and d are selected so as to maintain electroneutrality of the electrode active material.

Claims 101 - 153 are currently pending in the present Application, and stand rejected.

### 3. Rejections Under 35 U.S.C. §102(b)

Claims 101 - 109, 116 - 134 and 141 - 153 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,721,070 to Shackle ("Shackle 070"), as well as Rinaldi, "The Crystal Structure of Graphite, Complex Phosphate Not a Garnetoid" Bulletin de Mineralogie, vol. 101(5-6), pp. 543-7 (1978) ("Rinaldi reference").

#### 3.A. Shackle '070

Claims 101 - 109, 116 - 134 and 141 - 153 stand rejected under 35 U.S.C. §102(b) as being anticipated by Shackle '070. Shackle '070 discloses, among other things, an electrode material represented by the general formula (I):



wherein:

- (i) M is an alkali metal ion,
- (ii) T is a metal ion capable of existing in more than one stable oxidation state, and is selected from the group consisting of Mn, Fe, V, Ti, Co, Cu, Cr, Sn, Pb, W and Mo;
- (iii) A is a multi-element anion with a negative charge greater than 1, and is selected from the group consisting of  $\text{SiO}_4$ ,  $\text{TiO}_4$ ,  $\text{VO}_4$ ,  $\text{FeO}_4$ ,  $\text{MnO}_4$  and  $\text{PO}_4$ ;
- (iv) x is from about 1 to about 20;
- (v) y is from about 1 to about 4; and
- (vi) z is from about 1 to about 7.

Shackle '070 teaches that in some embodiments, the electrode material is "doped" by adding "other anions" (e.g.  $O^{2-}$ ,  $S^{2-}$ ,  $OH^{-1}$ ,  $F^{-1}$  and  $Cl^{-1}$ ). (See, Col. 4, ll. 34 - 67 of Shackle '070).

In contrast, Claims 101 - 109, 116 - 134 and 141 - 153 of the present Application recite, among other things, an electrode active material represented by the general formula (II):



wherein,

- (a) A is selected from the group consisting of Li, Na, K, and mixtures thereof, and  $0 < a \leq 8$ ;
- (b) M comprises one or more metals, wherein at least one of the one or more metals is capable of undergoing oxidation to a higher valence state, and  $1 \leq b \leq 3$ ;
- (c) Z is selected from the group consisting of a hydroxyl, a halogen, and mixtures thereof, and  $0 < d \leq 6$ ;

wherein A, M, Z, a, b and d are selected so as to maintain electroneutrality of the electrode active material

First, Shackle '070 fails to: (1) provide any teaching of a stoichiometric relationship between the "other anions" and the variables A, M, and T, (2) provide examples of active materials containing such "other anions," and (3) describe how to make electrode active materials "doped" with such "other anions."

Second, Shackle '070 *does not specifically recite as a subgenus*, electrode active materials such as those represented by general formula (II). Instead, it is necessary to pick-and-choose from among the multitude of possible selections for the variables A, M, T, z, y and z of general formula (I), and then "dope" into the material the "other anions" described in Shackle '070 (despite the absence of any teaching of the stoichiometric amount of the "other anions" to be added, any teaching of a stoichmetric relationship between the "other anions" and the variables A, M, and T, and without any teaching as to how to "dope" in such "other anions"), in order to derive the specific subgenus of electrode active materials described by general formula (II). Accordingly, Shackle does not anticipate Applicant's claimed electrode active materials, because Applicant's claimed electrode active materials (as represented by general formula (II)) are not "*clearly named*" in Shackle '070. (See, M.P.E.P., Rev. 2, May 2004, §2131.02).

Second, Applicant's claimed electrode active materials could not be "*at once envisaged*" from the teachings of Shackle '070, by one with ordinary skill in the art. Shackle's general formula (I) *embraces a vast number of electrode active materials*, not a limited number of materials which might allow one with ordinary skill in the art to *envisage* Applicant's claimed invention. Shackle '070 fails to provide any reason or benefit for selecting, among the multitude of active materials embraced Shackle's general formula (I) in combination with the teachings that in some embodiments the electrode material is "doped" by adding "other anions," those electrode active materials recited in Applicant's Claims.

Furthermore, Shackle '070 lacks any teaching which would *suggest* to one with ordinary skill in the art to pick-and-choose from among the multitude of possible selections for A, M, T, x, y and z of Shackle's general formula (I), then "dope" into the material the "other anions" described in Shackle '070, in order to arrive at Applicant's claimed electrode active materials.

Stated differently, Shackle '070 lacks any teaching which would motivate one with ordinary skill in the art to substitute, as a particular combination, the following variables into Shackle's general formula (I), and then "dope" into the material the "other anions" described in Shackle '070:

- (1)  $M = \text{Li, Na, K, or a mixture thereof,}$
- (2)  $A = \text{PO}_4,$
- (3)  $0 < x \leq 8,$
- (4)  $1 \leq y \leq 3,$  and
- (5)  $z = 3.$

Accordingly, Applicant respectfully submits that the electrode active materials recited in Claims 101 - 109, 116 - 134 and 141 - 153 could not be *envisaged* by one with ordinary skill in art, based on the teachings of Shackle '070.

Finally, Applicant further submits that neither does Shackle '070 support a rejection under 35 U.S.C. §103(a). (See, M.P.E.P., Rev. 2, May 2004, §2144.08). In chemical cases, to establish a *prima facie* case of obviousness under Section 103(a) for a claimed species or subgenus in view of a single prior art reference, (1) a claimed species must fall within or be embraced by the genus taught in the reference, and (2) the reference must provide some motivation or suggestion to choose the claimed species/subgenus from among the compounds defined by the genus.

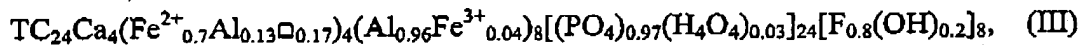
As noted above, Shackle '070 lacks any teaching which would motivate one with ordinary skill in the art to pick-and-choose from among the multitude of possible substitutions for A, M, T, z, y and z, as a particular combination, electrode active materials wherein (1) M of Shackle's general formula (I) is selected from the group consisting of Li, Na, K, and mixtures thereof, (2) A is  $\text{PO}_4$ , (3)  $0 < x \leq 8$ , (4)  $1 \leq y \leq 3$ ,

and (5)  $z = 3$ , then “dope” into the material the “other anions” described in Shackle ‘070. For this reason alone, Applicant’s claimed invention is not *prima facie* obvious in view of the teachings of Shackle ‘070.

Therefore, Applicant respectfully submits that Claims 101 - 109, 116 - 134 and 141 - 153, are patentably distinct from Shackle ‘070. Accordingly, Applicant respectfully requests withdrawal of the Examiner’s present rejection.

### 3.B. The Rinaldi Reference

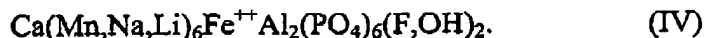
Claims 101 - 109, 116 - 134 and 141 - 153 stand rejected under 35 U.S.C. §102(b) as being anticipated by the Rinaldi reference. The Rinaldi reference discusses the results of a study of *non-metamict* griphite by X-ray diffraction spectroscopy. According to the Rinaldi reference, the formula of the subject griphite is represented by structural formula (III):



wherein:



The Examiner cites <http://webmineral.com/data/Griphite.shtml> (“webmineral webpage”), which discloses that griphite has an isometric - diploidal crystal structure (Space Group Pa3) and is represented by the chemical formula (IV):



First, Applicant notes that it is not clear from the contents of the webmineral webpage *when the effective prior art date of the webpage first occurred*. In other words, it is unknown from the webmineral webpage when the chemical formula cited by the Examiner was first known. Therefore, Applicant submits that the webmineral webpage should not be considered prior art against the present Application.

Second, the webmineral webpage states the formula (IV) noted above is the *chemical* formula for griphite, not the *empirical* formula as asserted by the Examiner. The Examiner has asserted that the formula (IV) described in the webmineral webpage can be rewritten as  $(\text{Mn}, \text{Na}, \text{Li})_3\{\text{Fe}_{0.5}\text{Ca}_{0.5}\text{Al}\}(\text{PO}_4)_3(\text{F}, \text{OH})$ . However, by doing so, the Examiner has effectively redefined the structural interpretation of griphite. Furthermore, the webmineral webpage does not teach or suggest that calcium (Ca), iron (Fe) or aluminum (Al) occupy the same crystallographic site, which the Examiner implicitly asserts by rewriting chemical formula (IV) as  $(\text{Mn}, \text{Na}, \text{Li})_3\{\text{Fe}_{0.5}\text{Ca}_{0.5}\text{Al}\}(\text{PO}_4)_3(\text{F}, \text{OH})$ .

Third, the Rinaldi reference discloses a *non-metamict* griphite described by structural formula (III). The Examiner has failed to explain how the Rinaldi reference anticipates Applicant's claimed electrode active materials. However, Applicant's claimed electrode active materials are patentably distinct from the *non-metamict* griphite (structural formula (III) herein) described by Rinaldi reference, because (among other reasons) the stoichiometric value for the phosphate ( $\text{PO}_4$ ) moiety of structural formula (III) differs from the stoichiometric value for the phosphate ( $\text{PO}_4$ ) moiety of Applicant's claimed electrode active materials, as described by general formula (II) herein.

Therefore, Applicant submits that Claims 101 - 109, 116 - 134 and 141 - 153, are patentably distinct from the Rinaldi reference. Accordingly, Applicant respectfully requests withdrawal of the present rejection.

#### 4. Rejection under 35 U.S.C. §103(a)

Claims 110 - 115 and 135 - 140 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Shackle '070, in view of U.S. Patent No. 6,017,654 to Kumta et al. ("Kumta '654").

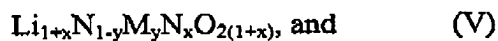
As noted above, Shackle '070 discloses, among other things, an electrode material represented by the general formula (I):



wherein:

- (i) M is an alkali metal ion,
- (ii) T is a metal ion capable of existing in more than one stable oxidation state, and is selected from the group consisting of Mn, Fe, V, Ti, Co, Cu, Cr, Sn, Pb, W and Mo;
- (iii) A is a multi-element anion with a negative charge greater than 1, and is selected from the group consisting of SiO<sub>4</sub>, TiO<sub>4</sub>, VO<sub>4</sub>, FeO<sub>4</sub>, MnO<sub>4</sub> and PO<sub>4</sub>;
- (iv) x is from about 1 to about 20;
- (v) y is from about 1 to about 4; and
- (vi) z is from about 1 to about 7.

As noted by the Examiner, Shackle does not teach or suggest that T of general formula (I) may comprise two or more metals. However, Kumta '654 discloses doped lithiated metal oxides represented by formulas (V) and (VI):





wherein:

- (i) M is one or more transition metals selected from titanium, vanadium, chromium, manganese, iron, cobalt, and aluminum; and
- (ii) N is a group II element selected from magnesium, calcium, strontium, barium, and zinc.

Kumta '654 teaches that the lithiated metal oxides of general formulas (V) and (VI) are doped with a divalent cation, wherein the dopants are added in amounts so that all or a portion of the dopant atoms occupy sites in the crystal lattice that would otherwise be occupied by transition metal atoms. (See, Kumta '654, Col. 4, ll. 30-45). Kumta '654 further teaches that the dopants may create defect centers in the crystal lattice which, in turn, increases the oxidation state of the transition metal ions. Increasing the oxidation state of the transition metal ions decreases the Jahn-Teller distortion effects known to affect layered crystal structures which, in turn, enhances the active material voltage durability and cyclability. (See, Kumta '654, Col. 5, ll. 50-66).

The Examiner has asserted that although Kumta '654 discusses "doping effects in terms of crystal structures with a R3m symmetry, one of ordinary skill in the art would [sic] the advantages of doping would similarly apply to other crystal structures." The Examiner has further asserted that it would have been obvious to one with ordinary skill in the art to "include divalent cations on [sic] transition metal sites of the Shackle cathode materials in order to create defect centers, increase the oxidation sate [sic] of the transition metals and thus improve [sic] electrochemical properties of the [Shackle] cathode materials, as taught by Kumta et al."

Applicant submits that Claims 110 - 115 and 135 - 140 are patentable over Shackle '070 and Kumta '654, individually and in combination. First, Shackle '070 lacks any teaching which would motivate one with ordinary skill in the art to pick-and-choose

from among the multitude of possible substitutions for A, M, T, z, y and z of Shackle's general formula (I), then "dope" into the material the "other anions" described in Shackle '070, in order to derive the electrode active materials claimed by Applicant and represented by general formula (II) herein. Stated differently, Shackle '070 lacks any teaching which would motivate one with ordinary skill in the art to pick-and-choose from among the multitude of possible substitutions for A, M, T, z, y and z of Shackle's general formula (I), as a particular combination, electrode active materials wherein (1) M is selected from the group consisting of Li, Na, K, and mixtures thereof, (2) A is  $\text{PO}_4$ , (3)  $0 < x \leq 8$ , (4)  $1 \leq y \leq 3$ , and (5)  $z = 3$ , and then "dope" into the material the "other anions" described in Shackle '070.

Second, Applicant submits that one with ordinary skill in the art would not be motivated to combine the teachings of Shackle '070 with the teachings of Kumta '654. While Kumta '654 does recognize that layered oxides suffer from reduced voltage durability and cyclability as a result of Jahn-Teller distortion effects, *neither* reference teaches or suggests that: (1) halo/hydroxyl-containing polyanion-based electrode materials suffer from reduced voltage durability and cyclability as a result of Jahn-Teller distortion effects; (2) doping the metal site of a halo/hydroxyl-containing polyanion-based electrode material with a divalent cation yields defect centers in the material's crystal lattice; or (3) creation of defect centers in the crystal lattice of a halo/hydroxyl-containing polyanion-based electrode material decreases the Jahn-Teller distortion effects on the structure which, in turn, yields enhanced voltage durability and cyclability. Accordingly, absent the above-noted three teachings, one with ordinary skill in the art would not be motivated to combine the teachings of Shackle '070 with the teachings of Kumta '654.

Third, the Examiner's assertion that "one of ordinary skill in the art would [sic] the advantages of doping [the layered oxides described in Kumta '654] would similarly apply to other crystal structures" is unsupported. Applicant submits that in this instance, one with ordinary skill in the art would not presume the advantages of doping layered oxides would similarly apply to other crystal structures, let alone halo/hydroxyl-containing polyanion-based materials, absent the above-noted three teachings.

Further, the Examiner's general assertion that those with ordinary skill in the art would presume the doping effects on one crystal structure would have the same effect on other crystal structures is not taught in the references relied upon by the Examiner, and therefore constitutes official notice. This assertion is not based on common knowledge, and Applicant respectfully challenges the Examiner to provide documentary evidence to support the above-noted assertion.

Fourth, the Examiner's overall conclusion is based on unsupported assumptions. The Examiner has concluded that it would have been obvious to one with ordinary skill in the art to "include divalent cations on [sic] transition metal sites of the Shackle cathode materials in order to create defect centers, increase the oxidation sate [sic] of the transition metals and thus improve [sic] electrochemical properties of the [Shackle] cathode materials, as taught by Kumta et al."

As can best be inferred from the Examiner's conclusion, the Examiner appears to be asserting that: (1) halo/hydroxyl-containing polyanion-based electrode materials suffer from reduced voltage durability and cyclability as a result of Jahn-Teller distortion effects; (2) doping the metal site of a halo/hydroxyl-containing polyanion-based electrode material with a divalent cation yields defect centers in the material's crystal lattice; and (3) creation of defect centers in the crystal lattice of a halo/hydroxyl-containing polyanion-based electrode material decreases the Jahn-Teller distortion effects affecting

the structure which, in turn, yields enhanced voltage durability and cyclability. However, these assertions of fact are not taught in the references relied upon by the Examiner, and therefore constitute official notice. These assertions are not based on common knowledge, and Applicant respectfully challenges the Examiner to provide documentary evidence to support the above-noted assertions.

In summary, Applicant submits that Claims 110 - 115 and 135 - 140 are patentable over Shackle '070 and Kumta '654, both individually and in combination. First, before the references could be combined, one would have to pick-and-choose from among the possible variables for A, M, T, z, y and z of Shackle's general formula (I), and then "dope" into the material the "other anions" described in Shackle '070, in order to arrive at Applicant's claimed electrode active materials (as represented by general formula (II) herein). However, Shackle '070 lacks any teaching which would *suggest* to one with ordinary skill in the art to pick-and-choose from among the multitude of possible selections for A, M, T, z, y and z of Shackle's general formula (I), and then "dope" into the material the "other anions" described in Shackle '070, in order to derive Applicant's claimed electrode active materials.

Second, one would have to apply the teachings of Kumta '654 to the subgenus selected from Shackle '070. However, Shackle '070 and Kumta '654 fail to teach or suggest that: (1) halo/hydroxyl-containing polyanion-based electrode materials suffer from reduced voltage durability and cyclability as a result of Jahn-Teller distortion effects; (2) doping the metal site of a halo/hydroxyl-containing polyanion-based electrode material with a divalent cation yields defect centers in the material's crystal lattice; and (3) creation of defect centers in the crystal lattice of a halo/hydroxyl-containing polyanion-based electrode material decreases the Jahn-Teller distortion effects affecting the structure which, in turn, yields enhanced voltage durability and cyclability.

Accordingly, based on the remarks stated above, Applicant submits that Claims 110 - 115 and 135 - 140 are patentable over Shackle '070 and Kumta '654, both individually and in combination. Accordingly, Applicant respectfully requests withdrawal of the present rejection.


5. Summary

In view of the remarks presented herein, Applicant submits that all objections and grounds for rejection stated in the present Office Action have been overcome. Accordingly, Applicant respectfully submits that Claims 101 - 153 are allowable over the prior art of record. Should anything further be required, the Examiner is respectfully requested to telephone the undersigned at 702-558-1071.

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